Praxair Services, Inc.

Technical Solutions for the Industrial World.

A Unique Approach for Monitoring CO2 Emissions at the Ground Surface

May 2007

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Perfluorocarbon Tracer Characteristics

- Chemically inert, non toxic, non radioactive
- Very low aqueous solubility (hydrophobic)
- Very low background in the environment <0.1 parts per trillion
- Measurable in the field with mobile laboratory
- No retardation of tracer movement relative to CO2 movement in saline aquifer
- 8 different tracers available through Praxair

Seeper Trace

- Seeper Trace is a technology developed by Praxair for the detection of small leaks (seepers) from cross country pipelines.
- It is becoming standard technology in hydro tests of cross-country pipelines for finding leaks that do not surface.
- Leaks are detected by sampling and analyzing above-ground air along the pipeline.
- Seeper Trace detection sensitivity is 0.001 parts per trillion which gives it the ability to detect pipeline leaks from above ground.

How Seeper Trace works (continued)

- The technician changes the tube after every 5 minutes of walking (approximately every 800 FT) and he marks the locations of each sample on the ground.
- The sample tubes are analyzed in the field using specialized gas chromatography.
- When the tracer is detected in a sample tube, the technician returns to the sample location on the pipeline and collects more samples from the same section of pipe in order to determine the exact location of the leak.

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FIELD SAMPLING EQUIPMENT

- **The field sampling equipment consists of a backpack-mounted battery-operated pump, with an air pick-up that drags on the ground behind the operator. Air is pumped over the shoulder of the operator, and passes through two sample tubes carried in front.**

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SAMPLE COLLECTION

- **Technician carries two containers for sample tubes. One for clean tubes, and one for used tubes. He changes the sample tubes every five minutes while walking, and marks the location on the ground with a flag where the tube is changed, and records the tube numbers. One technician can sample up to 8 km of pipeline per day.**




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ON-SITE ANALYTICAL LAB




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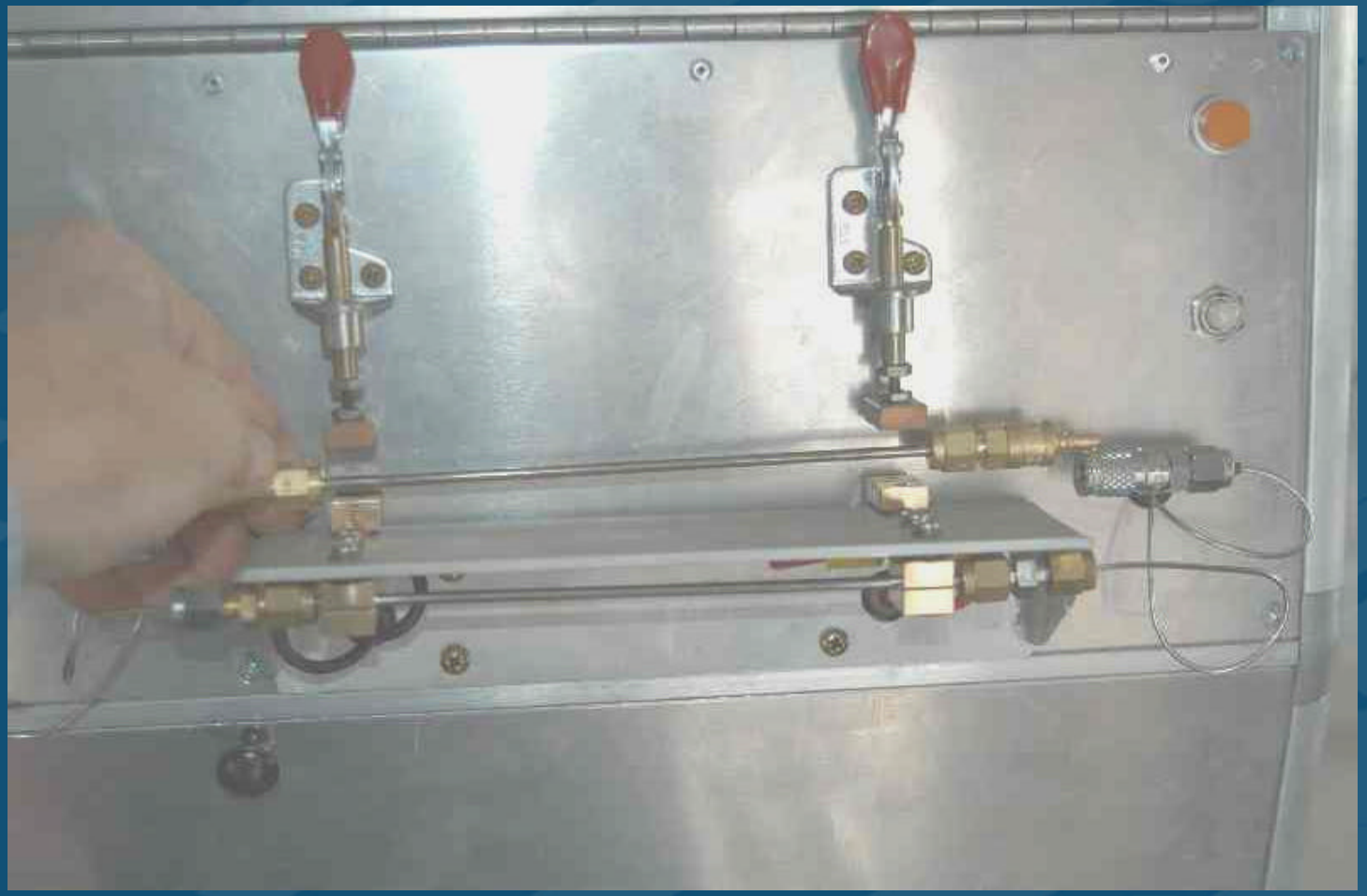
SAMPLE TUBE ANALYSIS

- The sample tube is placed on the analyzer (sample processing unit) for desorption and analysis.



FIELD ANALYTICAL EQUIPMENT

- This slide shows the automated sample processing unit with attached gas chromatograph. Each analysis takes about 5 minutes.
- The analytical equipment is located in a trailer that is normally parked near the pipeline.

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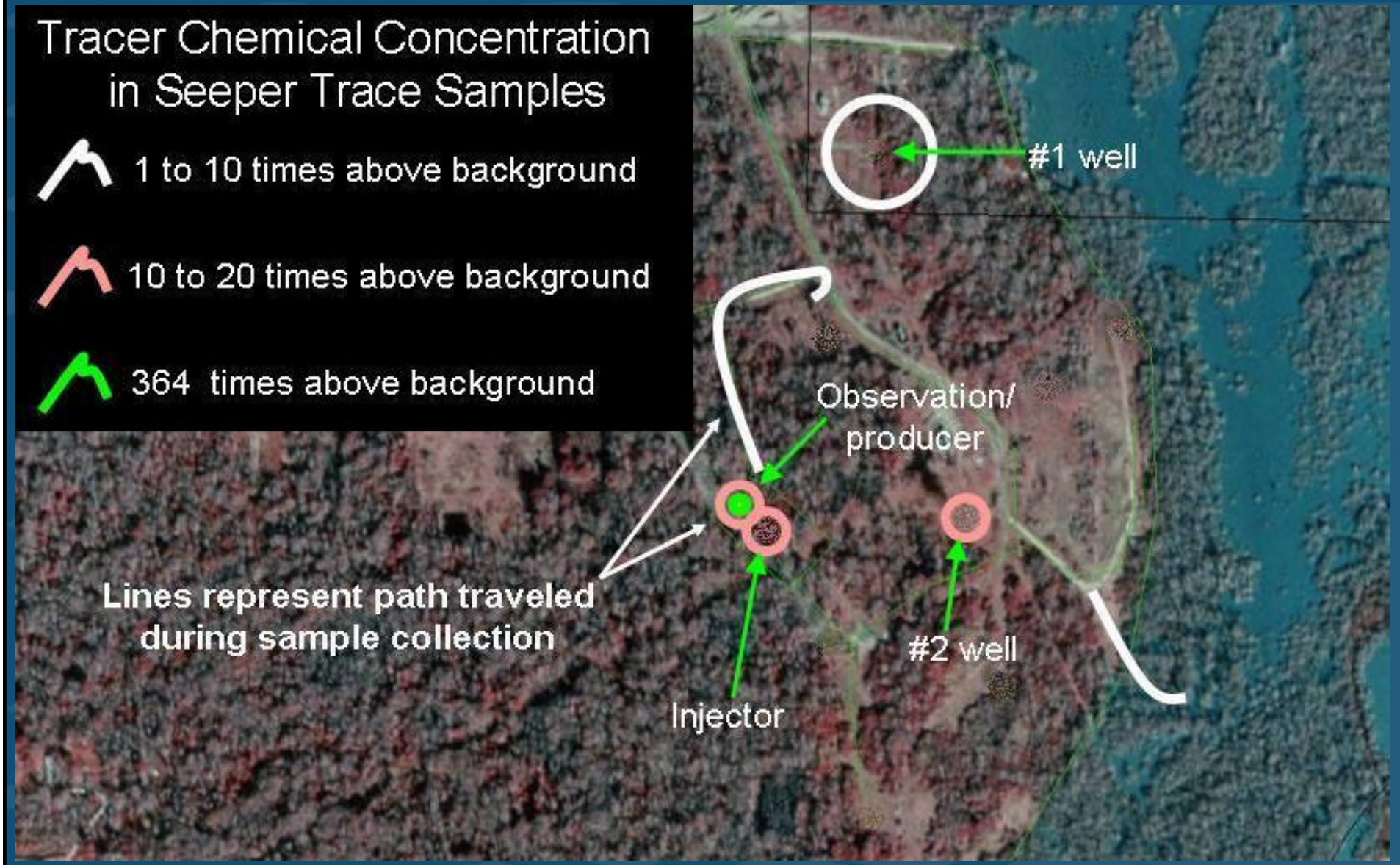
RESULTS



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Questions Tracers Can Answer

- Identify Leaks
  - Abandoned wells
  - Well casings
  - Geologic features
- Positively identify the injected gas
- Transport times and pathways
- Communication between strata
- Mixing mechanisms